November 1947 ET-247

United States Department of Agriculture
Agricultural Research Administration
Bureau of Entomology and Plant Quarantine

IMPROVED TECHNIQUES FOR MASS REARING OF THE CIGARETTE BEETLE AND THE TOBACCO MOTH

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Techniques for the mass rearing of the cigarette beetle (Lasioderma serricorne (F.)), and of the tobacco moth (Ephestia elutella (Hbn.)) have been developed at the Richmond, Va., field laboratory of this Bureau. Much of the early work of rearing the cigarette beetle was reported by Livingstone et al. (2), but many modifications and improvements of these methods were developed later.

The cigarette beetle is a most satisfactory insect for mass rearing. It is easy to handle, stands crowding, and is not especially susceptible to disease. Because of the ease with which it may be reared and handled, it offers many advantages as a test insect.

The tobacco moth is not a very satisfactory insect for mass rearing. It will not tolerate crowding, therefore only relatively few insects can be reared in a container, and it is subject to a disease which is difficult to control.

Description of Rearing Room

For the most satisfactory results in rearing these insects it was found necessary to have an insulated room in which constant temperature and humidity could be maintained. A small room, about 8 by 10 by 10 feet was found satisfactory. Such a room was insulated with wallboard made from sugarcane fiber. The door opening into the room was also covered with the wallboard, and weather strips were installed around the edges of the door. Shelves were built to accommodate the rearing containers. A small table mounted on casters served as a convenient workbench (see figure 1).

Temperature and Humidity Control

It was found that a uniform temperature of 80° F. was about the optimum for these insects. A radiator connected to the regular hot-water heating system of the building afforded some heat in winter, but a supplementary source of heat was necessary to maintain a constant temperature.

1/ W. D. Reed, E. M. Livingstone, A. W. Morrill, Jr., J. P. Vinzant, and Herschel Pollard developed many of the earlier methods used in rearing these insects.

Such a source was provided by a small electric heater of the resistance type, controlled by a thermostat. This heater was placed on the floor in front of the humidifying apparatus, so that the fan of the humidifier would help circulate the hot air.

The humidifying apparatus in a metal cabinet consisted of a fan and of a perforated copper tube from which water trickled over a layer of shredded wood fiber lining the sides of the cabinet. The flow of water and the running of the fan were controlled by a humidistat. The fan drew air through the moist fiber and blew it out into the room, so that constant relative humidity of 70 percent was maintained.

On a control panel above the electric heater and the humidifier were mounted the thermostat and the humidistat, which automatically turned the equipment on or off (see figures 2 and 3).

A hygrothermograph placed in the room enabled a close check to be made on the operation of the heating and humidifying equipment. With this equipment, equable temperature and humidity could be maintained. Under most conditions the temperature could be held at a constant figure of plus or minus 2° F., and the relative humidity at plus or minus 2 percent.

Rearing Methods

Containers.--The most satisfactory type of rearing container for either insect was found to be the 1-pint fruit jar with a 2-piece screw top. This glass jar was of a handy size and could be readily cleaned and sterilized. When in use, the top of the jar was covered with a square of tightly woven cotton cloth, such as sheeting, and the metal rim of the top was screwed down over the cloth. This container provided a tight closure while permitting some entry of air (see figure 4).

Food.--Both the cigarette beetle and the tobacco moth will breed readily in many seeds and in cereal products, as well as in tobacco. The most satisfactory food tested was found to be a mixture of 5 pounds of corn meal and 6 ounces of dry yeast, either bakers' or brewers'. Both insects thrive on this mixture and it has proved satisfactory for about 10 years. One advantage of this food over tobacco is that larvae may be easily sifted from it and adults can be removed much more readily than from tobacco.

It was found desirable to fill the jars about one-third full of the meal-yeast mixture, and then to tamp it down firmly in the jar. The cigarette beetle could crawl about readily over the packed surface and seemed to prefer a firm material in which to oviposit.

Sterilization of food.--The eggs and newly hatched larvae of both the cigarette beetle and the tobacco moth are almost microscopic. It would be difficult to determine whether food was already infested by these or other insects. To insure pure cultures of the desired insects some method of sterilization was necessary. Heating the jars containing the corn meal and yeast in an electric oven at a temperature of 140° F.

for 4 hours proved satisfactory.

Obtaining eggs.--The eggs of the cigarette beetle are glued to the surface on which they are deposited. They cannot be easily sifted from corn meal because of the adherence of particles of the meal and because of their fragility. The beetle likes to oviposit in tiny cracks and crevices, and a tobacco stem (midrib of a leaf) is a preferred place. An easy method of obtaining cigarette beetle eggs is to split open short sections of tobacco stems, clamp the halves together with a paper clip, and introduce the sections into a cage of beetles. Many eggs will be deposited between the halves of the split stem and by separating the halves the eggs are readily accessible. The stems should be sufficiently moist so that they are not brittle (see figure 5).

The eggs of the tobacco moth have a tough integument and most of them are deposited loosely, not glued to any surface. Eggs can be obtained in quantity by confining large numbers of tobacco moths in a bell jar resting on a disk of fine-mesh wire gauze stretched over a wooden frame 1/2 of an inch thick. The moths readily oviposit upon the wire gauze, and most of the eggs drop through onto a piece of paper placed beneath to receive them. Large quantities of moth scales and appendages also pass through the gauze, but they can easily be removed by screening the material again onto a paper towel and rolling it from side to side. The scales that pass through even a fine sieve adhere to the rough surface of the towel, whereas the eggs do not.

Handling adults.--The cigarette beetle is a very small insect, only 2 to 3 mm. long, and can be handled most easily by a suction device. By means of an aspirator, or a device such as is shown in figure 6, individual beetles may be counted or mass collections quickly made. This device was operated by rubber tubing connected to the intake of an air compressor. However, in using a suction device care must be exercised not to use too much suction force, lest the insects strike the receiving jar hard enough to injure them. In the procedure described in this paper the suction was regulated by means of an adjustable pinchcock on the air line.

The tobacco moth is fragile and also very active. To handle this insect without injury, an anesthetic was found very helpful. Three or four drops of ether placed on the cloth top of the container soon quieted the moths. Caution should be exercised not to use too much ether, nor to leave the moths exposed to the fumes longer than necessary. However, with experience on the part of the operator, moths may be anesthetized, removed from the jar, and transferred to another container with little apparent injury and no loss.

Starting insect cultures.--Since cigarette beetle eggs cannot be readily handled, the most satisfactory method of obtaining mass cultures of this insect was found to be the introduction of adult beetles into each jar. Approximately 1 cc. (about 300) of active, newly matured beetles were placed in a jar. These beetles deposited their eggs in the corn meal and died. After approximately 2 weeks, the dead beetles were

removed from the jar by means of the suction device previously described.

Cultures of the tobacco moth were started by placing in each jar from 200 to 250 eggs, lifting them on the tip of a knife blade or small spatula and scattering them on top of the corn meal-yeast mixture.

The label and date were placed on the cloth top of each jar by means of a rubber stamp.

After a generation of insects had completed development, the glass jar was emptied and the jar and top were scrubbed with a brush in hot soapy water. The used cloth covers were discarded.

Life History

Cigarette beetle.--Under controlled conditions of 80°F. and 70 percent relative humidity, the entire life cycle of the cigarette beetle requires about 50 days. The length of the incubation period is about 7 days, the larval period about 30 days, the prepupal period about 5 days, and the pupal period about 8 days. There is usually a preoviposition period of 2 or 3 days. The adult feeds very little, if any, and, according to Runner (4), usually lives for 3 weeks or more.

Tobacco moth.--Under similar controlled conditions, the tobacco moth also has a life cycle of approximately 50 days. The incubation period lasts about 5 days, the larval period about 35 days, and the pupal stage about 10 days. This moth may mate and begin egg laying within 24 hours after emergence, according to Reed and Livingstone (3).

Parasites, Predators, and Diseases

In the rearing room the most annoying enemies of the cigarette beetle and the tobacco moth were certain mites, including the straw itch mite (Pediculoides ventricosus Newp.). A mite of Seiulus sp. and another mite, tentatively identified by H. E. Ewing as Monieziella angusta Banks, have also given considerable trouble, according to Bare (1). The most satisfactory methods of control have been as follows: Immediate elimination of any infested jars; quick removal and cleaning of all jars after emergence of adult beetles or moths; use of tight, closely woven cloth over jars; and wiping off the shelves with a solution of 2-percent chlordane in oil.

A hymenopterous parasite, Aplastomorpha calandrae How., and a pteromalid, Lariophagus distinguendus (Foerst.), were parasitic on the cigarette beetle in the laboratory, and sometimes a braconid, Microbracon hebetor (Say), attacked larvae of the tobacco moth. However, infestation by these parasites could be prevented by reasonable care and attention.

One of the worst problems encountered was an unidentified disease, apparently bacterial, which attacked the larvae of the tobacco moth. Once or twice this disease threatened to wipe out an entire stock of the tobacco moth. The only procedures that seemed of any value in combating

it were immediate discarding of infested jars, careful sterilization of all glassware, and reducing the number of tobacco moth larvae in each jar Crowding in the rearing jars seemed to favor the spread of the disease.

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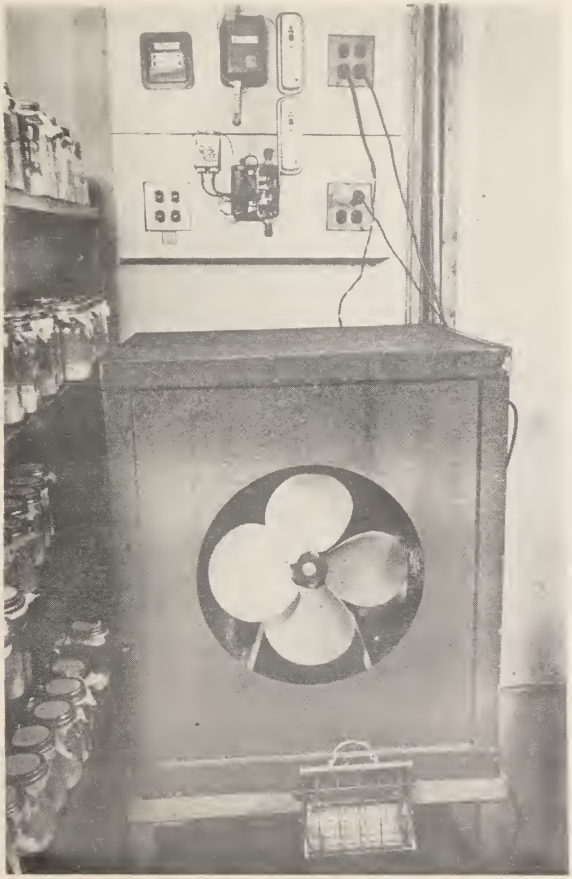

Figure 2.—Humidifier and control panel, with thermostat and humidistat. Note electric heater on floor in front of humidifier.

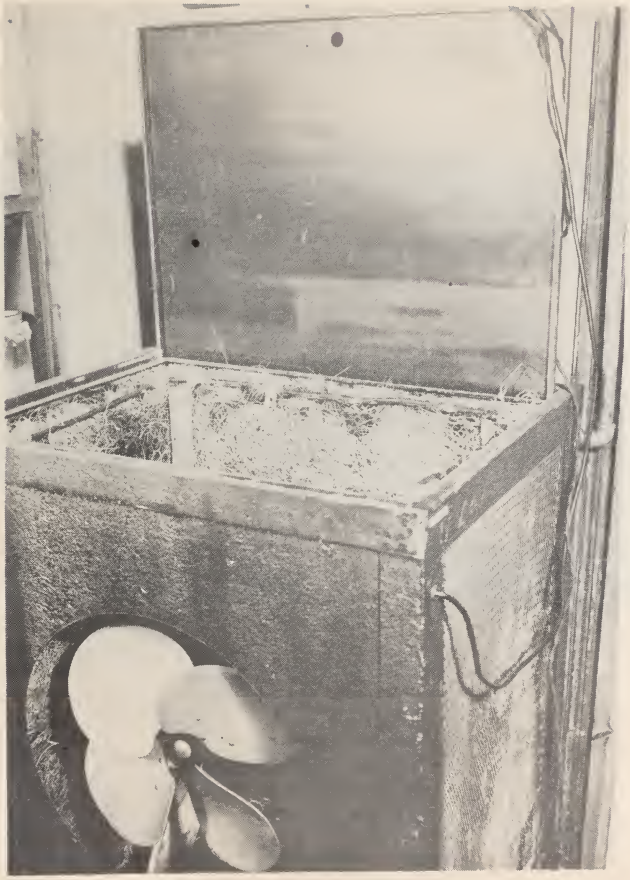

Figure 3.--Interior of humidifier showing water pipe above wood-fiber lining of cabinet. The fan is for circulation of the moist air.

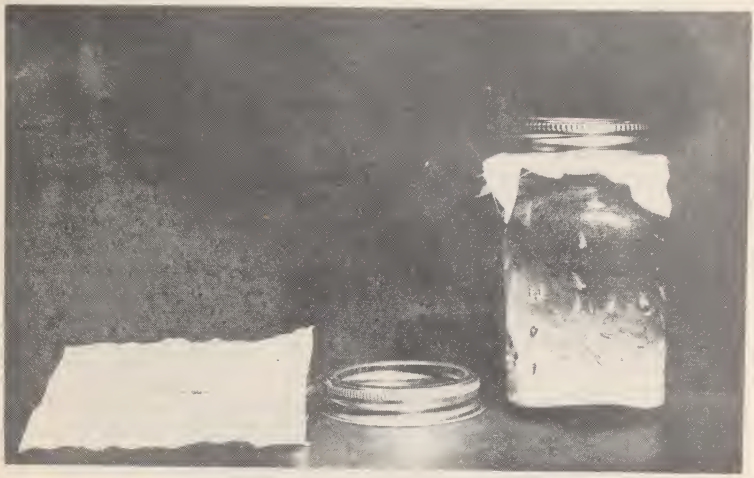

Figure 4.--Rearing jar for the cigarette beetle and the tobacco moth.

Figure 5.--Section of split tobacco stem showing eggs of the cigarette beetle adhering to interior surface.

Figure 6.--Suction device being used to collect adult cigarette beetles.